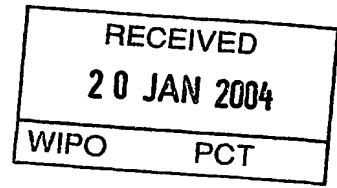




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I, JULIE BILLINGSLEY, TEAM LEADER EXAMINATION SUPPORT AND SALES hereby certify that annexed is a true copy of the Provisional specification in connection with Application No. 2002953429 for a patent by POWER AND COMMUNICATIONS LOGISTICS PTY LIMITED as filed on 18 December 2002.



WITNESS my hand this
Fifteenth day of January 2004

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TEAM LEADER EXAMINATION
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AUSTRALIA

PATENTS ACT 1990

PROVISIONAL SPECIFICATION

FOR THE INVENTION ENTITLED:-

"AN ELONGATE ELECTRICAL CONDUCTOR THAT IS ADAPTED FOR
ELECTRICALLY CONNECTING WITH AN ELECTRICAL CONTACT"

The invention is described in the following statement:-

FIELD OF THE INVENTION

The present invention relates to an elongate electrical conductor and in particular to an elongate electrical conductor that is adapted for electrically connecting with an electrical contact.

- 5 The invention has been developed primarily for providing common power and communications lines in domestic, commercial and public buildings and will be described hereinafter with reference to those applications. It will be appreciated, however, that the invention is not limited to those fields of use and is also suitable for providing only power or only communication lines, whether that be in the above 10 categories of buildings or otherwise.

BACKGROUND OF THE INVENTION

Any discussion of the prior art throughout the specification should in no way be considered as an admission that such prior art is widely known or forms part of common general knowledge in the field.

- 15 Recent prior elongate electrical conductors are disclosed in US patents 6,309,229 and 6,395,987, both of which are in the name of the present inventor. While the conductors disclosed in these patents provide possible solutions to the problems that are identified in the specification, they are relatively complex and difficult to manufacture, as well as occupying considerable volume for the current carrying capacity that is 20 accommodated.

These types of conductors are typically formed from a copper sheet and, for a unit length and current carrying capacity, are heavy and therefore relatively expensive and difficult to transport. Moreover, the production of the conductors results in the generation of considerable waste material.

25 SUMMARY OF THE INVENTION

It is an object of the present invention to overcome or ameliorate at least one of the disadvantages of the prior art, or to provide a useful alternative.

- According to a first aspect of the invention there is provided an elongate electrical conductor that is adapted for electrically connecting with an electrical contact, 30 the conductor including:

a longitudinally extending elongate body for defining a first contact surface; and

a plurality of longitudinally spaced apart ribs that extend from the body to respective free ends that are spaced apart from the first contact surface for allowing the contact to be progressed between the body and one or more of the ribs, each rib including a respective second contact surface that is opposed with the first surface

- 5 wherein, upon progression of the contact between the body and the one or more ribs, the first surface and the respective one or more second surfaces are resiliently biased into engagement with the contact.

In a preferred form, the spacing between the free ends and the first contact surface is greater than the spacing between the first and second contact surfaces.

Preferably, the ribs are resiliently mounted to the body. More preferably, the ribs are resilient.

Preferably also, the body is a conductive sheet having two opposite elongate longitudinally extending edges, wherein the ribs extend from one of the edges. In some embodiments, the body includes a further conductive strip that extends from the other of the edges. The further conductive strip is preferentially used in high current applications.

15 In a preferred form, adjacent free ends are mechanically connected to collectively increase the resilient bias. More preferably, the adjacent free ends are mechanically connected by respective intermediate integrally formed segments. Even more preferable, the segments collectively define with the free ends an engagement face for guiding the progression of the contact into biased engagement with the first and second surfaces. In the preferred embodiments, the engagement face is continuous.

20 Preferably, the engagement face is opposed with and inclined away from the first surface. More preferably, the engagement face extends between an inner edge and an outer edge that terminates opposite the other edge.

25 Preferably also, when the first and second surfaces are biased into engagement with the contact, the inner edge abuts the contact. More preferably, the ribs restrain longitudinal movement of the contact.

- 30 In a preferred form, the conductor is formed from a continuous conductive sheet that is folded upon itself along a longitudinal fold line. More preferably, the sheet is punched to form the ribs. However, in other embodiments, the sheet is cut or otherwise formed.

Preferably, the first contact surface is substantially planar and the second contact surfaces are arcuate. In some embodiments the second contact surfaces include a compound arc.

According to a second aspect of the invention there is provided an elongate electrical conductor that is adapted for electrically connecting with an electrical contact, the conductor including:

- 5 a longitudinally extending elongate first body for defining a substantially planar contact surface; and
- 10 for defining an arcuate contact surface that is opposed with the planar surface wherein, upon progression of the contact between the first and second bodies, the planar and the arcuate surfaces are resiliently biased into engagement with the contact.

Preferably, the arcuate contact surface is segmented. More preferably, the second body includes a plurality of longitudinally spaced apart ribs that extend from the first body to respective free ends which collectively define the arcuate surface. Even more preferably, the free ends are mechanically connected. In the preferred embodiments the free ends are mechanically interconnected by respective intermediate integrally formed segments.

20 Preferably, the first body is substantially planar and includes two opposite faces, one of which defines the planar contact surface. More preferably, the second body is arcuate and includes opposite convex and a concave faces, the formed defining the arcuate contact surface.

According to a third aspect of the invention there is provided a conduit for an elongate electrical conductor that is adapted for electrically connecting with an electrical contact, the conduit including:

- a longitudinally extending housing;
- 25 one or more mounting formations disposed within the housing for captively retaining the conductor to the housing;
- 30 an opening in the housing for receiving the contact and thereby allowing the contact to be brought into engagement with the conductor; and

a closure that is mounted to the housing for moving between an open configuration and a closed configuration with respect to the opening when the contact is and is not received within the opening respectively.

Preferably, the closure is mounted to the housing for rotation between the open and closed configurations. More preferably, the closure is hinged to the housing. Even more preferably, the closure is resiliently biased toward the closed configuration. In some embodiments, the closure includes a longitudinal line of weakness about which it is resiliently deformed from the closed configuration.

Preferably also, the contact is part of a contact assembly and, as the assembly is progressed into the opening, the closure is moved toward to open configuration. More preferably, the contact assembly engages the closure to effect progression toward the open configuration.

In a preferred form, the mounting formation is a retaining channel that extends continuously through the housing. More preferably, the channel includes a continuous open end for receiving the contact. More preferably, the open end is downwardly facing. In the preferred embodiments, the open end defines the bottom of the channel.

Preferably, the housing includes a plurality of spaced apart channels for captively retaining respective conductors. More preferably, the channels are parallel. In the preferred embodiment, the channels longitudinally coextend and are transversely spaced apart.

Preferably also, the housing is extruded.

In a preferred form, the closure, in the closed configuration, extends across the opening. More preferably, the opening extends longitudinally and the conduit includes a plurality of closures that, in the closed configuration, collectively extend longitudinally across substantially all of the opening. Even more preferably, movement of one closure between the open and closed configuration occurs independently of movement of any other of the closures. In the preferred embodiment the closures are modular.

Preferably, the closure is mounted inside the housing and, in the closed configuration, extends upwardly from the housing and across the opening. More preferably, the closure is hinged at or adjacent to the housing wherein the movement between the open and closed configurations occurs within the housing. In the preferred embodiments, the opening includes two opposite edges and the closure extends from a

mounting end that is hingedly engaged with the housing adjacent to one of the opposite edges, to a free end that, in the closed configuration, is disposed adjacent to the other of the opposite edges.

Preferably also, the mounting formation includes a locating formation for

5. orientating the conductor for resilient deformation upon engagement with the contact. More preferably, the conductor includes a plurality of engagement faces for engaging with the contact, and the locating formation orientates the engagement faces for resiliently deforming into engagement with the contact. Even more preferably, the locating formation is a protrusion that extends from the mounting formation.

10. In other embodiments, the mounting formation includes a channel having an open end defined by the opening. More preferably, the opening is downwardly facing. Even more preferably, the closure is a flap that, in the closed configuration, extends across substantially all of the opening and which is resiliently deformed by the contact into the open configuration.

15. According to a fourth aspect of the invention there is provided a conduit for an elongate electrical conductor having two opposed engagement elements that are adapted for electrically connecting with an electrical contact, one of the elements being substantially planar and the other being arcuate, the conduit including:

a longitudinally extending housing;

20. one or more mounting formations disposed within the housing for captively retaining the conductor to the housing;

an opening in the housing for receiving the contact and thereby allowing the contact to be brought into engagement with the conductor; and

25. one or more locating formations associated with the mounting formations for orientating the conductor to ensure that the substantially planar engagement face is inclined with respect to the contact.

Preferably, the conduit includes a closure that is mounted to the housing for moving between an open configuration and a closed configuration with respect to the opening when the contact is and is not received within the opening.

30. Preferably also, the arcuate engagement face includes a compound arc.

In a preferred form, the mounting formations captively retain the conductor within the housing. For typical domestic AC voltages this is required to ensure for the

safety of persons in the vicinity. However, for low voltage DC applications the design of the conduit is able to accommodate the conductor being partially or substantively disposed outside of the housing.

- According to a fifth aspect of the invention there is provided a conduit for an elongate electrical conductor that is adapted for electrically connecting with an electrical contact, the conduit including:
- a longitudinally extending housing;
 - an open ended channel disposed within the housing for captively retaining the conductor within the housing;
 - 10 an opening in the housing for receiving the contact and thereby allowing the contact to be brought into engagement with the conductor; and
 - 15 a closure that is disposed within the housing adjacent to the open ended channel for moving between a closed configuration and an open configuration for providing a barrier to unintended access to the conductor.

Preferably, the closure is moved into the open configuration when the contact is brought into engagement with the conductor. More preferably, only that portion of the closure adjacent to the contact is moved into the open configuration.

- According to a sixth aspect of the invention there is provided a contact assembly for electrically connecting with a plurality of conductors contained within a conduit, the contact including:

- a housing that is movable into engagement with the conduit; and
- 20 a plurality of contact formations mounted to the housing and which are movable into engagement with respective conductors in a predetermined sequence.

Preferably, the housing is movable into releasable engagement with the conduit and the contact formations are movable into releasable engagement with the respective conductors.

- Preferably also, the contact formations include at least two pins, wherein one of the pins protrudes further from the housing than the other. More preferably, the contact formations include three parallel pins that extend transversely from the housing and terminate at free ends that are transversely spaced apart.

In a preferred form, the contact includes at least two parallel pins and the relative transverse offset between the pins and the respective conductors is such as to provide the predetermined sequence.

- Preferably, the contact assembly includes an active pin and a neutral pin, and the predetermined sequence comprises the neutral pin and then the active pin engaging the respective conductors. More preferably, the contact assembly includes an active pin, a neutral pin and an earth pin, and the predetermined sequence comprises the earth pin and then the neutral pin and the active pin engaging the respective conductors. Even more preferably, the neutral pin and the active pin substantially simultaneously engage with respective conductors. In other embodiments, however, the predetermined sequence comprises the earth pin and then the neutral pin and then the active pin engaging the respective conductors.

10 Preferably also, the pins are movable out of engagement with the respective conductors, that movement occurring in the reverse of the predetermined sequence.

15 According to a seventh aspect of the invention there is provided an elongate electrical conductor that is adapted for electrically connecting with an electrical contact, the conductor including:

20 a longitudinally extending elongate conductive sheet having a first face and a second face opposite to the first face, wherein the first face defines a first contact surface; and

25 a plurality of longitudinally spaced apart ribs that extend transversely from the sheet and back along at least a portion of the first contact surface but not along the second face, each rib including a respective second contact surface wherein, upon progression of the contact between the sheet and the one or more ribs, the first surface and the respective one or more second surfaces are resiliently biased into engagement with the contact.

30 Preferably, the faces are joined along a first common longitudinal edge and a second common longitudinal edge and the ribs extend from the first edge and terminate in respective free ends. More preferably, the second contact surfaces are disposed intermediate the first edge and the respective free ends. Even more preferably, the free ends terminate between the first and second edges. In some embodiments the free ends

extend beyond the second edge. However, the free ends do not extend around the second edge.

BRIEF DESCRIPTION OF THE DRAWINGS

Preferred embodiments of the invention will now be described, by way of example only, with reference to the accompanying drawings in which:

Figure 1 is a perspective view of a conduit according to the invention in combination with a contact assembly, also according to the invention, that is mounted to the conduit in a movable configuration;

Figure 2 is a perspective view of the contact assembly of Figure 1;

Figure 3 is an enlarged view of the conduit and contact assembly of Figure 1, with the contact in an operative configuration;

Figure 4 is an enlarged side view of the conduit of Figure 1;

Figure 5 is a side view of the conduit and contact assembly of Figure 3;

Figure 6 is an enlarged side view of the conduit and the contact assembly as they are moved relative to each other and from the movable configuration toward the operative configuration;

Figure 7 is a side view similar to Figure 6 with the conduit and contact assembly in the operative position;

Figure 8 is a cut-away rear perspective view of the conduit and contact assembly intermediate the operative and movable configurations;

Figure 9 is an enlarged side view of the conduit of Figure 1 illustrating a movable closure in a closed configuration;

Figure 10 is a view similar to that of Figure 9 showing the closure in the open configuration;

Figure 11 is a side view of a conductor according to the invention;

Figure 12 is a perspective view of the conductor of Figure 11;

Figure 13 is a cross sectional view of a roll of conductors of Figure 11;

Figure 14 is a side view, similar to Figure 11, of a high current rated conductor according to the invention;

Figure 15 is a perspective view of the conductor of Figure 11 extending between two conduits of Figure 1;

Figure 16 is a perspective view of the conductor at an intermediate stage of its manufacture; and

Figure 17 is a side view of the contact assembly of Figure 1 showing the contact formations.

5. DESCRIPTION OF THE PREFERRED EMBODIMENTS

- Referring to Figures 1 to 10 and Figures 15 and 17, and particularly to Figures 1, 4 and 17, there is illustrated an elongate insulating conduit 1 for three generally parallel elongate electrical conductors 2, 3 and 4 that are adapted for electrically connecting a contact assembly 5 having corresponding electrical contacts in the form of pins 7, 8 and 9.
10. Conduit 1 includes a longitudinally extending extruded plastic housing 11 of substantially consistent cross-sectional shape. Three open-ended channels 12, 13 and 14 are disposed within housing 11 for captively retaining respective conductors 2, 3 and 4 within the housing. An elongate longitudinally extending opening 15 in housing 11 receives assembly 5 and thereby allows pins 7, 8 and 9 to be brought into engagement with respective conductors 2, 3 and 4. As best shown in Figure 4, two resiliently deformable plastics closures 17 and 18 are disposed within housing 11 adjacent to open ended channels 13 and 14 for moving between a closed configuration, as shown, and an open configuration for providing a barrier to unintended access to conductors 3 and 4.
15. Housing 11, in this embodiment, is a three-piece construction and includes a rigid plastics mounting bracket 21 that is attached to a wall or other support element that the housing is to extend along or between. The attachment, in this embodiment, is by a plurality of longitudinally spaced metal screws 22 that extend through apertures (not shown) in bracket 21. In other embodiments, the attachment is affected by other devices, for example, bolts, adhesive, rivets and the like.
20. Bracket 21 includes a rear plate 23, a base 24 that extends forwardly from the bottom of plate 23, and a front plate 25 that extends substantially normally from base 24. Plate 23 includes a snap-lock fitting 26, while plate 23 and base 24 collectively define a retention channel 27.
25. Plate 23, base 24, plate 25, fitting 26 and channel 27 are integrally formed.
30. Housing 11 also includes an extruded plastic front bracket 28 having a front plate 29 that is spaced apart from and extends in the same plane as plate 25 for defining opening 15. A rigid wall assembly 30 extends rearwardly from plate 29 and, together

with that plate, define channels 12, 13 and 14. Assembly 30 also includes a snap-lock fitting 31 and a locking post 32 that respectively complementarily interact with fitting 26 and channel 27.

Plate 29, assembly 30, fitting 31 and post 32 are integrally formed.

5 Channels 12, 13 and 14 include respective retention protrusions in the form of pairs of opposed longitudinally extending ridges 35 and 36 that extend toward each other to define the open end of the respective channels. These ridges retain conductors 2, 3 and 4 in the respective channels, and include lower bevelled edges to guide pins 7, 8 and 9 into the channels.

10 The channels also include mounting formations, in the form of respective abutments 37 and recesses 55, that shape the interior of the channels for ensuring the respective conductors are inclined with respect to the pins. This functionality will be described in more detail below.

15 Base 24 includes a mounting formation in the form of a longitudinal channel 38 that coextends with housing 11 and which includes pairs of spaced apart internal abutments. An extruded plastic closure 39 extends within housing 11 for movement between an open configuration, as shown in Figure 4, and a closed configuration, as shown in Figure 9. Closure 39 has a longitudinal length of about 50 mm and includes a support formation, in the form of a ribbed spigot 40, that is complementarily fixedly mounted within channel 38 in an interference fit.

20 Closure 39 also includes a shutter 41 that is hinged to spigot 40 for movement between the open configuration, where the shutter is substantially horizontal, and the closed configuration, where the shutter is substantially vertical. The free end of shutter 41 includes an integrally formed peak 42 that extends normally away from the shutter to provide additional resistance to ingress of unwanted items into housing 11.

25 The longitudinal length of housing 11 varies depending upon the site in which it is installed. Typically, that longitudinal length is in the range of about 150 mm to many tens of metres. In other embodiments, however, smaller or greater lengths are used where the installation requires. Accordingly, as closure 39 is about 50 mm in length, the preferred embodiments make use of a plurality of like closures that, in the closed configuration, collectively and substantially extend across all of opening 15. In those

embodiments where the longitudinal length of housing 11 is not an integral multiple of the length of closure 39, one or more of the closures are trimmed to size.

Shutter 41 is resiliently biased into the closed configuration, and progressed into the open configuration as assembly 5 is progressed into aperture 15. As assembly 5 will 5 at any one time engage, at most, two adjacent shutters, the other shutters will remain in the closed configuration and thereby continue to obstruct the ingress of dirt, dust, and other items into housing 11.

In some embodiments closure 39 is omitted. In other embodiments, closure 39 is integrally formed with base 24.

10 It should be noted that the closure has also been omitted from some of the drawings, although this is primarily for the purposes of clarity in illustrating other features of the preferred embodiments.

Housing 11 is formed in a continuous length, and cut to size for the installation being undertaken. Additionally, conductors 2, 3 and 4 are also continuous. If necessary, 15 discontinuous housings and conductors are used, although this is generally less preferred.

The continuous nature of housing 11 and conductors 2, 3 and 4 allow assembly 5 to be received within opening 15, and pins 7, 8 and 9 engaged with respective conductors 2, 3 and 4 at any longitudinal position along housing 11. As will be 20 described below, assembly 5 is therefore able to be positioned, as required. While in some embodiments assembly 5, once positioned, is fixed, in most embodiments assembly 5 is releasably engaged with the conductors and movable, as desired. This provides considerable flexibility in design and placement of assembly 5 and, hence, considerable flexibility in placement of electrical apparatus that connect with assembly 5 25 to draw power from one or more of the conductors or to transmit and/or receive data via one or more of the conductors.

Assembly 5 includes a generally cylindrical insulating plastic body 45 that coaxially and rotatably supports a circular front face 46. This face has a plurality of apertures arranged in a predetermined orientation corresponding to the standard socket configuration for the jurisdiction concerned. In the illustrated embodiment face 46 30 includes three apertures in the UK format. Contained within body 45 and behind the apertures are sprung electrical contacts (not shown) for engaging with respective pins of

a complementary electrical plug when those pins are received within the apertures. These contacts, in turn, are electrically connected to respective pins 7, 8 and 9. In this embodiment pin 7 is the earth pin, pin 8 is the active pin, and pin 9 is the neutral pin of a single-phase 240 Volt supply system.

5. Body 45 supports an intermediate annular adjustment band 47 that is mechanically connected to face 46 for allowing manual relative rotation between body 45 and face 46 between a movable configuration, as shown in Figure 1, to an operative configuration, as shown in Figure 3. The rotation is about a common axis 48.

Pins 7, 8 and 9 are directly mechanically connected with band 47 via an axle 49 that is coaxial with axis 48. These pins extend radially from the axle and therefore also rotate through a 90° arc as the band is rotated by 90° relative to body 45. In the movable configuration, pins 7, 8 and 9, while located within housing 11, are parallel with and spaced apart from the conductors and, as such, assembly 5 is longitudinally movable along opening 15. In the operative configuration, however, the pins are normal to and engaged with the respective conductors and, as such, assembly 5 is restrained against longitudinally progression along opening 5. To further illustrate, reference is made to Figure 5, where assembly 5 is in the operative configuration. As shown, pins 7, 8 and 9 extend vertically from axle 49 and are engaged at their free ends with respective conductors.

20. In other embodiments the pins rotate through other than 90° to progress between the movable and operative configurations. Moreover, in some embodiments, there is a mechanical link including gearing operable between band 47 and axle 49. Typically, the gearing is a reduction gearing to provide mechanical advantage to any manual input. While this necessitates, in some embodiments, the rotation of band 47 through more than 25. 90°, it also allows a greater clamping force between pins 7, 8 and 9 and respective conductors 2, 3 and 4 while containing the manual power required to be exerted. In general terms, the greater the clamping force between the pins and the respective conductors, the better quality the electrical contact and therefore the lower the resistance of the contact. This is particularly important for communication signals, as there contain 30. high frequency components that are more susceptible to degradation due to poor contacts.

Band 47 includes a lever 50 that extends radially outwardly from the band. This lever provides mechanical assistance to a user when manually progressing the band between the operable and movable configurations. In other embodiments, band 47 includes a predetermined arrangement of engagement formations (not shown) for inter-engaging with a complementarily shaped tool.

- In use, bracket 21 is cut to the required longitudinal length and attached via screws 22 to an adjacent support surface, typically a wall, floor or ceiling. Bracket 28 is cut to the same length and continuous conductors 2, 3 and 4 are inserted into channels 12, 13 and 14. Post 32 is then placed in channel 27, and bracket 28 rotated so as to bring fittings 26 and 31 into snap-locked engagement and thereby fixedly retain brackets 21 and 28 together.

- Assembly 5, with band 47 rotated into the movable configuration, is presented to conduit 1 in the approximate desire longitudinal location on that conduit. Pins 7, 8 and 9 and axle 49 are then progressed through opening 15. As this occurs, axle 49 engages the adjacent shutter 42 and progresses it from the closed configuration to the open configuration. Only the shutter engaged by axle 49 will be progressed to the open configuration, the remaining shutters will remain in the closed configuration.

- Assembly 5 is then longitudinally progressed along opening 15 until the final positioning with respect to conduit 1 is determined. If the assembly is progressed longitudinally beyond the initially engaged shutter to a subsequently engaged shutter, the initially engaged shutter automatically returns to the closed configuration, while the subsequently engaged shutter progresses to the open configuration. In this embodiment, the shutters are resiliently biased toward the closed configuration.

- With the location of assembly 5 determined, the user manually rotates band 47 to progress the pins from the movable configuration into the operable configuration of Figures 5 and 7. It will be appreciated that closures 17 and 18 are resiliently deformed where they are adjacent to respective pins 8 and 9. Otherwise, those closures remain as a barrier to ingress into channels 12, 13 and 14 of contaminants or unintended items.

- Figures 8 and 17 illustrate the pins intermediate the movable and the operative configurations. With particular reference to Figure 17, it will be understood that as the pins rotate they engage with the respective conductors in a predetermined sequence. In this embodiment, as the pins move from the movable configuration to the operable

configuration that sequence includes the first contact being made between pin 7 and conductor 2, and subsequent simultaneous contact being made between pin 8 and conductor 3 and pin 9 and conductor 4 respectively. In other embodiments, pin 9 and conductor 4 are configured to make contact prior to the contact between pin 8 and conductor 3.

It will also be appreciated that, in this embodiment, pin 7 is an earth pin and is always the first pin to contact the respective conductor, and the last pin to be in contact with the respective conductor.

The sequential engagement of the pins with the respective conductors also 10 reduces the maximum manual forces required to rotate band 47.

During movement of the pins from the operable configuration, the breaking of the contacts between the pins and the conductors is the reverse of the predetermined sequence.

It will be appreciated, from the teaching herein, that the predetermined sequence 15 for a given embodiment having co-radial pins of equal thickness is determined by the relative lengths of the pins and the relative offset between the conductors in the direction that the length of the pins is measured. In other embodiments the same effect is achieved by radially offsetting the pins on axis 49, or by having pins of a different radial width.

In practice, conduit 1 supports a plurality of spaced apart like assemblies 5 (not 20 shown) which provide significant design flexibility. Moreover, if, with time, it is desired to longitudinally re-position one or more of assemblies 5, band 47 is progressed to the movable position. Thereafter, assembly 5 is either longitudinally translated along opening 15, or removed from opening 15 altogether and reinserted at the desired 25 location. In any event, once the positioning at the desire location is affected, band 47 is once again returned to the operative configuration and assembly 5 is once again operatively connected with the conductors.

That is, as the power and communication requirement of a building, or room 30 within that building, change, conduit 1 allows the location of the power and communication outlets to be quickly and easily modified to accommodate any change in the required functionality.

- Reference is now made to Figures 11 and 12, which specifically illustrate conductor 2. It will be appreciated that conductors 3 and 4 are of the same construction and offer the same functionality as conductor 2 and, as such, will not be described separately. As discussed above, conductor 2 is longitudinally elongate and is adapted for electrically connecting with an electrical contact in the form of pin 7. Conductor 2 includes a longitudinally extending elongate metal conductive body in the form of a copper sheet 61 for defining a first substantially planar contact surface 62 and an opposite face 63 that meet at common parallel longitudinal edges 64 and 65. A plurality of longitudinally spaced apart resiliently deformable ribs 66 extend from sheet 61 to respective free ends 67 that are spaced apart from the surface 62 for allowing pin 7 to be progressed between sheet 61 and one or more of ribs 66. Each rib includes a respective arcuate contact surface 68 that is opposed with surface 62 wherein, upon progression of pin 7 between sheet 61 and the one or more ribs 66, surface 62 and the respective one or more surfaces 68 are resiliently biased into engagement with the pin.
- 10 In the configuration shown in Figure 11, the spacing between ends 67 and surface 61 is greater than the spacing between surfaces 62 and 68. All of ribs 63 extend from edge 64 to allow edge 65 and ends 67 to collectively define an opening 69 for receiving pin 7.
- 15 Ribs 66 extend transversely away from edge 64 and back along substantially all of surface 62. The ribs do not extend at all along face 63 and, hence, minimise the required transverse thickness of conductor 2.
- 20 Adjacent ends 67 are mechanically and electrically connected to collectively increase the resilient bias between surfaces 62 and 68 when engaged with pin 7. In this embodiment, adjacent ends 67 are mechanically connected by respective intermediate 25 integrally formed segments 70. These segments have respective top edges 71, and bottom edges that extend between and which lie flush with ends 67. Segments 70 collectively define with ends 67 an engagement face 72 for guiding the progression of pin 7 into biased engagement with surfaces 62 and 68. In this embodiment, face 72 is substantially planar, continuous and opposed with and inclined with respect to surface 30 62. In other embodiments, face 72 is arcuate.

Segments 70 allow conductor 2 to have a higher clamping force upon pin 7 as the clamping bias is provided not only by those ribs that are in direct contact with the pin,

but also the adjacent ribs. Moreover, with pin 7 in the operative position, it will be in direct contact with surface 68 of one or two of the ribs. The immediately adjacent ribs, however, will bias the edges 71 into abutment with the longitudinal edges of pin 7, and thereby further retain that pin in the operative position. That is, conductor 2 offers both 5 clamping and a mechanical locking of pin 7 in the operative position. This effect is best shown in Figure 7.

It will be appreciated that in other embodiments surfaces 68 include a compound arc.

Sheet 61 is the primary current carrying component of conductor 2. While some 10 current inevitably flows along a path defined by ends 67 and segments 70, this is typically less than that flowing through sheet 61. The primary function of ribs 66 and intermediate segments 70 is to provide clamping and locking engagement with pin 7 and to otherwise ensure it is secured in good electrical contact with sheet 61.

Sheet 61 extends substantially along a plane and surface 62 is substantially 15 planar to provide a large contact area between surface 62 and the adjacent opposed planar surface of pin 7. It will be appreciated that this area is far greater than the contact area between surface 68 and the adjacent surface of pin 7. This asymmetry also allows the transverse width of conductor 2 to be minimised. Moreover, less regard need be had to the current capacity of ribs 66 – in that the dimensions of the ribs is not critical – as 20 less reliance is placed upon this current path. Rather, the highly conductive, continuous and regularly shaped sheet 61 offers a high quality low resistance current path, while ribs 66 are intended more for optimising the electrical engagement of the pin with surface 62.

Conductors 2, 3 and 4 are continuous to provide as low a resistance path as 25 possible. This is also important for higher frequency signals, as discontinuities such as joints can provide sites for signal reflections and thereby compromise the data being communicated. Typically, the conductors are longer than conduit 1, and extend between adjacent like conduits. For example, reference is made to Figure 15 where two conduits 1 are mounted to respective support surfaces (not shown) and extend normally away 30 from each other. Conductors 2, 3 and 4 extend continuously through and between both conduits 1. Moreover, the conductors accommodate bending or folding about a vertical

axis (or axes). While the uniform bend in each conductor shown in Figure 15 extends through a total of 90°, in other embodiments alternative bends are accommodated.

It will also be appreciated that conductors 2, 3 and 4 are able to longitudinally slide in respective channels 12, 13 and 14. This is particularly important where bends such as that shown in Figure 15 are concerned, as the radius of the bends required is different for each conductor. This longitudinal sliding within the channels allows each conductor to progress to the least stressed position, and thereby best ensure that the bend is uniform. This absence of kinking and distortion of the conductors minimises any risk of degrading the conductor's mechanical performance – due to, for example, point loading – and electrical performance – due to, for example, creating a reflection site for high frequency signals.

Although Figure 15 illustrates the exposed conductors as they extend between adjacent conduits 1, in practice an intermediate corner conduit or bend conduit is used to provide continuous encasement of conductors 2, 3 and 4.

Bending and folding of conductors 2, 3 and 4 about the vertical axis is possible due to the substantially planar sheets 61, and the spaced apart ribs 66. It will be appreciated that such bending or folding does, in some cases, result in some buckling of segments 70 and ribs 66. While this is preferable avoided, it has been found in practice that this is not critical for domestic power applications as sheet 61 is the main current carrier. In circumstance where more extreme bending or folding is used, it is also possible to buckle sheet 61 or to bring sheet 61 into engagement with ribs 66. In the event that the conductors need only convey power, and not communications signals, then such buckling is rarely problematic, as assembly 5 is typically only mounted to conduit 1, not to an intermediate conduit.

Conductors 2, 3 and 4 are introduced into the respective channels by being feed into the longitudinal ends of conduit 1. However, in other embodiments, the conductors are introduced into respective channels 12, 13 and 14 by progressing through the open ends, in that they are resiliently deformed as they pass ridges 35 and 36. The typical end result being, for the example of conductor 2, that edge 65 and end 67 are adjacent to the upper side of ridges 35 and 36. Due to manufacturing tolerances and other factors it is not unusual for only one of edge 65 and end 67 to be engaged with the respective ridges. In fact, this is a design feature of conduit 1 and conductor 2 to ensure that sheet 61 is

inclined from the plane through which pin 7 rotates. As will be appreciated from the foregoing description, in this embodiment pin 7 rotates in a vertical plane.

While conductors 2, 3 and 4 are retained within the respective channels, they do have a limited degree of freedom for movement. Particularly, the inclusion and

- 5 placement of recess 55 encourages conductor 2, in the absence of pin 7, to rest under the influence of gravity such that sheet 61 is inclined by a small amount from the vertical. The inclination is such that end 67 is lower than edge 65. When pin 7 is first progressed past ridges 35 and 36 and into channel 12, its leading edges contact conductor 2. Specifically, one leading edge of pin 7 contacts surfaces 62 adjacent to edge 65, and the other leading edge contacts surface 72. Those contacts need not necessarily initially occur simultaneously. While this action of pin 7 may cause some upward movement of conductor 2, the contact with surface 62 causes conductor 2 to rotate slightly within channel 12 such that face 63 is brought into engagement with abutment 37. The engagement with abutment 37 occurs adjacent to edge 64 and, as such, sheet 61 is supported along face 63 at only two spaced apart points, these being at edge 64 — which is engaged with abutment 37 — and at edge 65 — that is abutted against the adjacent wall of channel 12. Accordingly, sheet 61 and surface 62 remain inclined with respect to the vertical.

- As pin 7 is further advanced into channel 12, it drives between surface 62 and face 72 to resiliently deform ribs 66 such that surfaces 62 and 68 are moved apart to allow progression of pin 7 into channel 12. As that progression occurs, the leading edge of pin 7 that is engaged with surface 62 slideably progresses along that surface toward edge 64. Moreover, that leading edge, being disposed intermediate edges 64 and 65, resiliently deforms sheet 61 toward the adjacent wall of channel 12 to further facilitate the movement apart of surfaces 62 and 68.

- Once the leading edges of pin 7 have progressed from end 67 and past surface 68, the deformation of sheet 61 is such as to bring surface 62 into contact with the adjacent surface of pin 7. In any event, once the leading edges of pin 7 extend to or slightly beyond edge 64, sheet 61 returns to the substantially planar configuration to establish the large contact area between the pin and surface 62.

During the progression of pin 7 into channel 12, ribs 66 are deformed to make way for that progression between surfaces 62 and 68. However, the ribs maintain

surfaces 62 and 68 in a resilient clamping bias with pin 7. While sheet 61 is being resiliently deformed the bias will be reduced. However, with pin 7 in the operative position, and surface 62 intimately electrically connected with that pin, the bias will be at a maximum as sheet 61 is, in that configuration, substantially planar and un-deformed.

- 5 Channel 12 and conductor 2 also interact such that end 67 of conductor 2 is abutted with the adjacent wall of the channel during the progression of pin 7 into the channel. Additionally, recess 55 ensures that rib 66 does not otherwise engage with that wall of the channel. In this situation, end 67 acts as a lever for applying additional clamping bias between surfaces 62 and 68 and the intermediate pin 7. It also enhances the probability of a large contact surface area between surface 62 and pin 7. An additional advantage is that the ribs adjacent to the rib or ribs that directly engage with pin 7 are resiliently urged toward sheet 61 and thereby contribute to locking pin 7 in the operative position.
- 10

- 15 When pin 7 is rotated from the operative to the movable configuration it is necessary to overcome the clamping and locking forces that have been applied by conductor 2. However, once this occurs, the sequence of events is substantially the reverse order of that described above.

- 20 Some embodiments of the invention are intended for high current applications. One example is a conductor 75 that is illustrated in Figure 14, where corresponding features are denoted by corresponding reference numerals. Sheet 61 includes a conductive copper strip 76 that is integrally formed with and which extends from edge 65 to overlap with all of face 63. In this embodiment strip 76 extends beyond edge 64. Although a gap is shown between sheet 61 and strip 76, it is preferred that this is minimised or eliminated.
- 25
- In other embodiments, strip 76 terminates intermediate edges 64 and 65. In further embodiments, strip 76 is folded back upon itself one or more times.

- Conductors 2, 3 and 4 are each formed from a continuous conductive sheet. By way of example, a preferred method of manufacturing conductor 2 will be provided below with reference to Figure 16. It will be appreciated by those skilled in the art that the other conductors are preferably manufactured with the same steps.

Initially, use is made of a longitudinally continuous copper sheet 81 having a nominal thickness and width of about 0.35 mm and 18 mm respectively. This is

sufficient to provide, in the finished product, a 20 Amp current carrying capacity at 240 Volts AC, along with the required clamping force.

Sheet 81 is significantly smaller than the corresponding sheet used to produce the prior art device. Accordingly, the raw material costs for the preferred embodiment, for the same current carrying capacity, is considerably less than that offered by the prior art. It also ensures, that for a given length of conductor, that conductor 2 will weigh less than the prior art and, hence, will be less expensive to not only obtain the raw materials, but also to transport the final product for installation.

This sheet is cleaned and then punched to form an array of asymmetric disposed longitudinally spaced apart generally rectangular apertures 82. This arrangement is illustrated in Figure 16. The punching operation also introduces four parallel broken lines of weakness 83, 84, 85 and 86 that extend longitudinally between the apertures. It will be appreciated that the metal remaining between adjacent apertures is to ultimately define ribs 66.

Sheet 81 is then again cleaned and a flexible plastic sheet 87 is adhered to one face of sheet 81. As sheet 81 is of considerable length, it is usual for a plurality of adjacent sheets 87 being used to collectively cover upward face of sheet 81. Sheet 87, in this embodiment, is made from a flexible resilient plastic sheet and:

1. Provides an electrically insulating and protective cover for the resultant conductor.
2. Facilitates the introduction of the conductor into channel 12 by reducing the likelihood of inadvertent and undesired binding engagement between the ribs and the adjacent channel walls.
3. Provides additional structural integrity to the conductor.
4. Contributes to the formation of constant radius curves between adjacent conduits that are angled with respect to each other.
5. Reduces the risk of entanglement or undesired snagging between adjacent coils of the resultant conductor when included in a multi-layer coil.

In other embodiments, sheet 87 is a laminate. One embodiment (not shown) includes a three layer flexible laminate having:

1. An outer plastic layer for providing the functionality referred to above;
2. An inner adhesive layer for adhering sheet 87 to conductor 2.

3. An intermediate conductive layer, such as a conductive foil, for providing electromagnetic shielding.

Sheet 81 is mandrel bent between lines 85 and 86 to define end 67 and the inclined face 72. A further mandrel bend is affected along a longitudinal central fold line that is parallel with and intermediate lines 83 and 84. The bend along the central fold line is such as to fold sheet 81 by 180° so that it extends back upon itself to form conductor 2, as shown in Figure 11. It will be appreciated that sheet 87 have been omitted from the drawings, other than Figure 16, for the purposes of clarity.

In other embodiments, sheet 87 is not used.

10 Other punching, bending and folding techniques are also applicable to the manufacture of conductor 2 from sheet 81.

The punching technique used in the embodiments described in the drawings results in about 17% of copper sheet 81 being converted to waste. That is, conductor 2 includes about 83% of the weight of copper originally included in sheet 81. For the prior art, the waste amounted to about 30% of the weight of the resultant conductor.

Once sheet 81 has been formed into conductor 2, it is wound into a multi-layer coil 90, as shown in Figure 13. The coil is subsequently transported to a building site or other installation site where it is progressively uncoiled as conductor 2 is feed into channel 12. Coil 90 is formed by securing an end of conductor 2 to a circular drum 91.

20 Drum 91 has an outwardly facing circumferentially extending surface 92 that is abutted with face 63 of conductor 2. Drum 91 is rotated to wind conductor 2 about the drum and then over its own length to form coil 90. As the coil is created, the substantially planar face 63 is being engaged with the underlying drum of coil. Accordingly, the risk of inadvertent engagement between ribs in adjacent coils of the multi-layer coil 90 is minimised both during the coiling and uncoiling of conductor 2.

30 The shape and configuration of conductors 2, 3 and 4 provides for a small transverse width of those conductors, as there are only two transversely spaced apart copper components, these being body 61 and ribs 66. Moreover, the sheet 81 is only folded back upon itself once. Even in the Figure 14 embodiment, where sheet 81 is folded back upon itself twice, the additional fold is such that the two components of the sheet are either closely adjacent or abutted together.

Some prior art conductors include considerably more transversely spaced components, typically four, and are therefore require more material to make, are more difficult to make, and are transversely wider. It is also more usual for the prior art conductors to include many folds back upon its length. The conductors of the present

5 embodiments, however, are minimally transversely wider than the respective pin that they are intended to engage. This allows conduit 1 to be thinner; less intrusive in retrofit installations; and installed in smaller cavities or spaces that would have been achieved through use of the prior art referred to above.

Other advantages of the preferred embodiments are that they provide for:

- 10 1. A reduction in the cost of the required raw materials; the manufacture; the handling and transportation; and the installation. As presently understood, the total cost of purchase and installation of the preferred embodiment of Figure 15 should be about half that of an equivalent prior art system.
- 15 2. A reduction in the amount of waste generated from the production of the conductor.
- 20 3. Increased safety through the provision of closures, and in particular closure 39.
- 25 4. The earth contact to be the first to contact, and the last to leave contact, with the respective conductor.
- 30 5. A reduced number of components, particularly for conduit 1. In the preferred embodiment, with the exception of conductors 2, 3 and 4, conduit 1 includes only three components, these being bracket 21, bracket 28 and closure 39. However, in embodiments where closure 39 is integrally formed with bracket 21, conduit 1 includes only two components.
6. A reduction in the installation time and the logistics in arranging for that installation due to the fewer required components. That is, separate components need to be separately sourced, cut to size and assembled. Accordingly, the far diminished number of components required by the present embodiments facilitates the installation of conduit 1.
7. Accommodates longitudinal progression of the conductors within the respective channels. This reduces point loading of the conductors and allows

for uniform bends to be formed by those conductors as they extend between conduits.

Although the invention has been described with reference to specific examples, it will be appreciated by those skilled in the art that it may be embodied in many other forms.

DATED this 18th day of December 2002.

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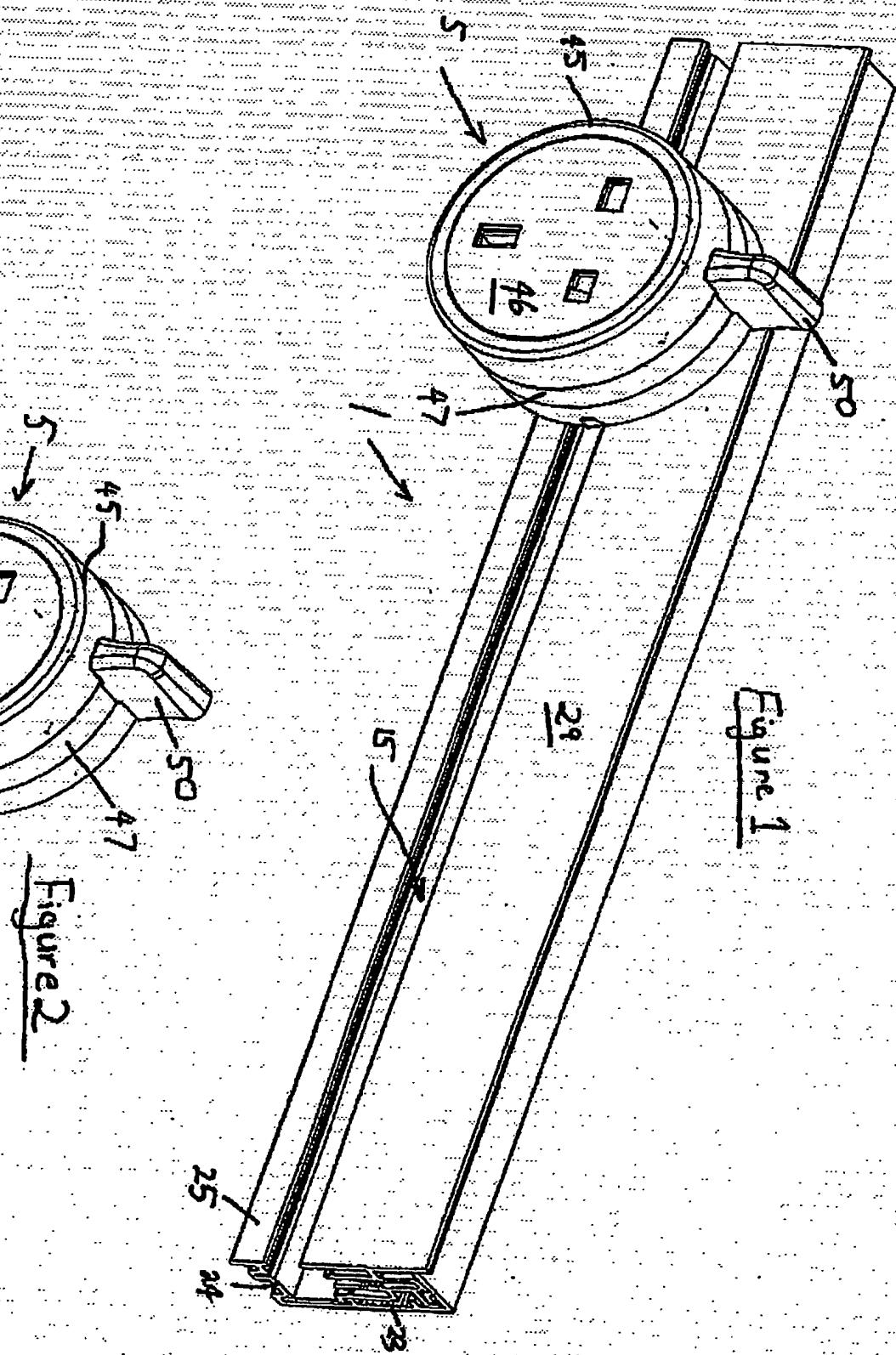
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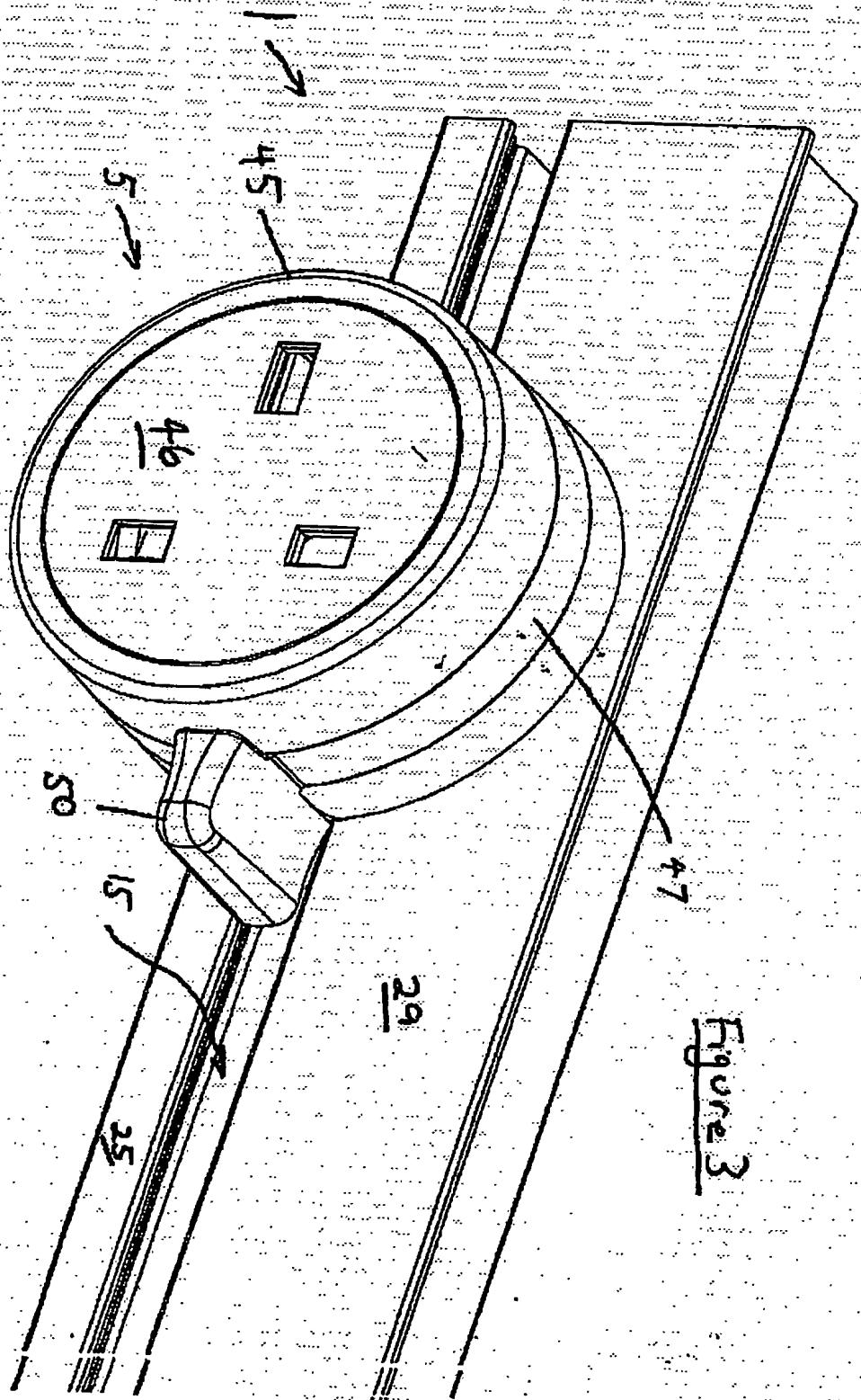
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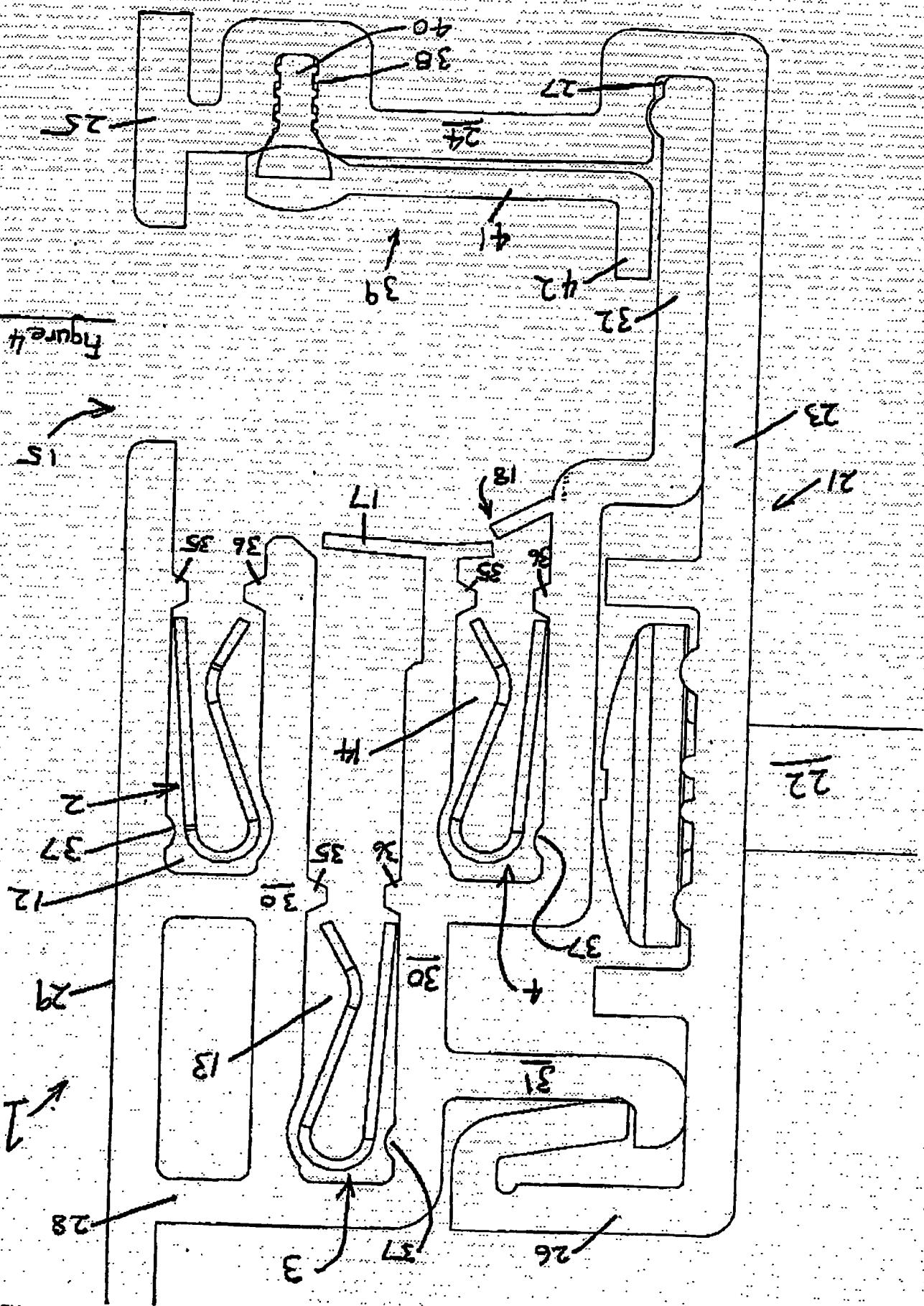
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Figure 1





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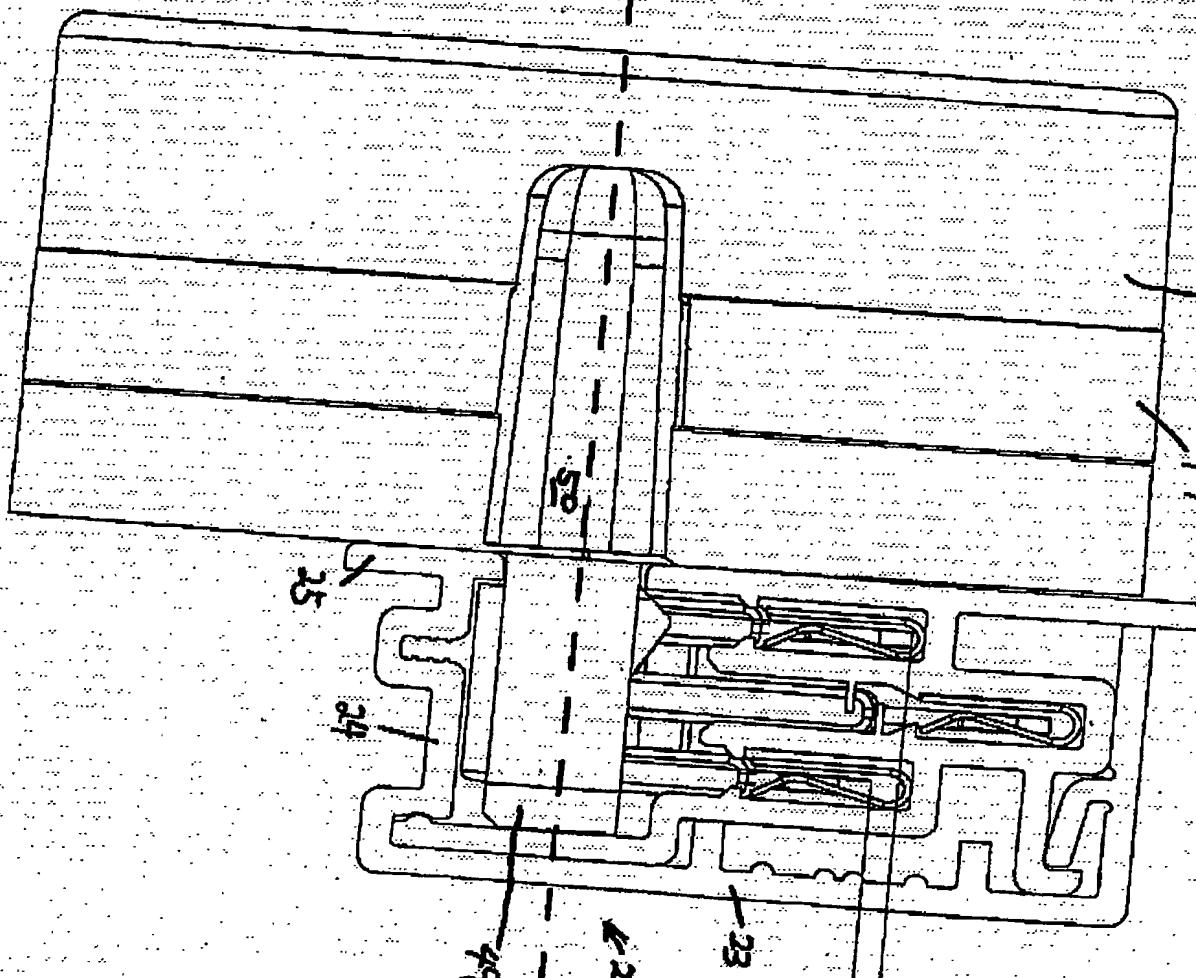
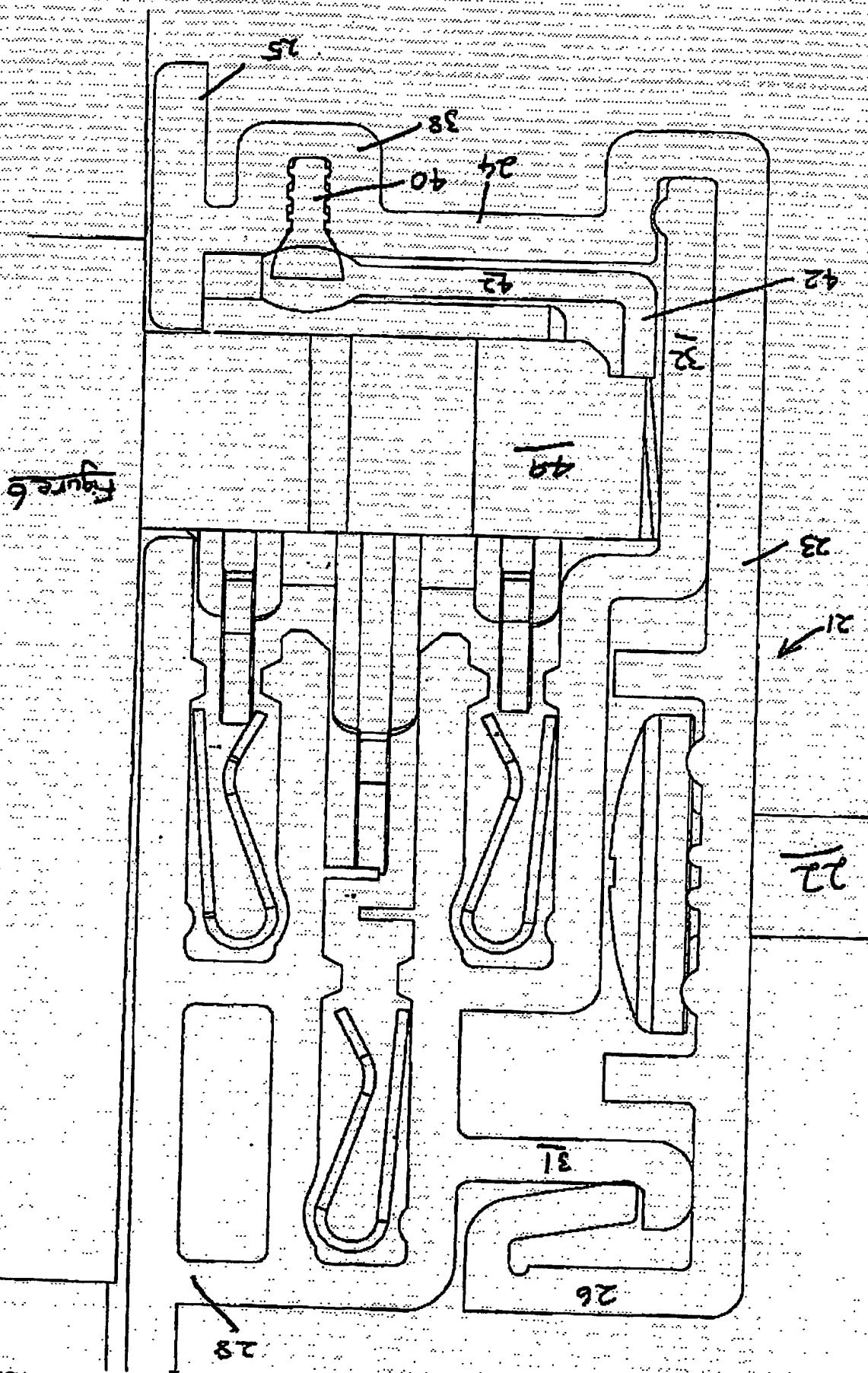
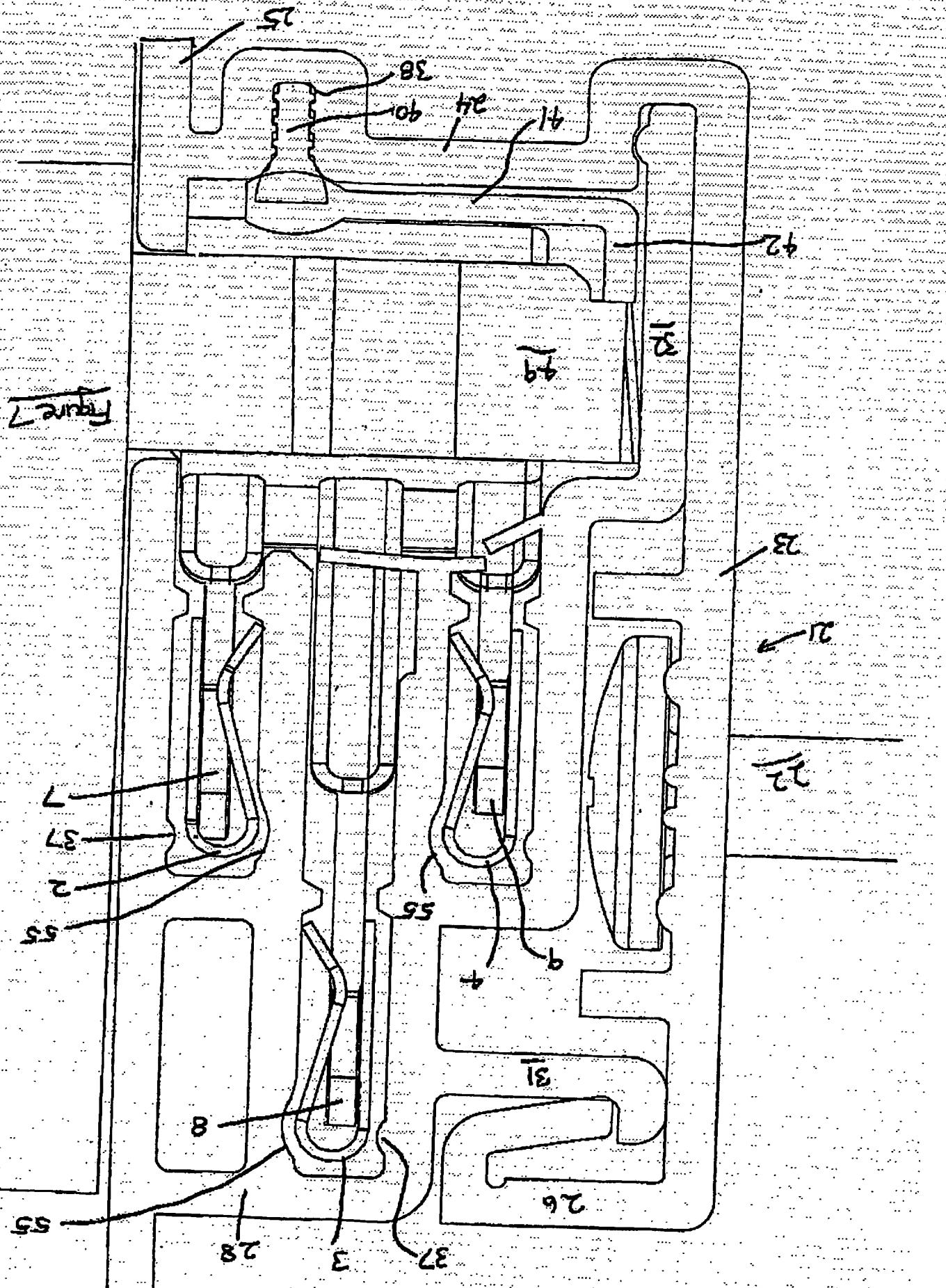


Figure 5





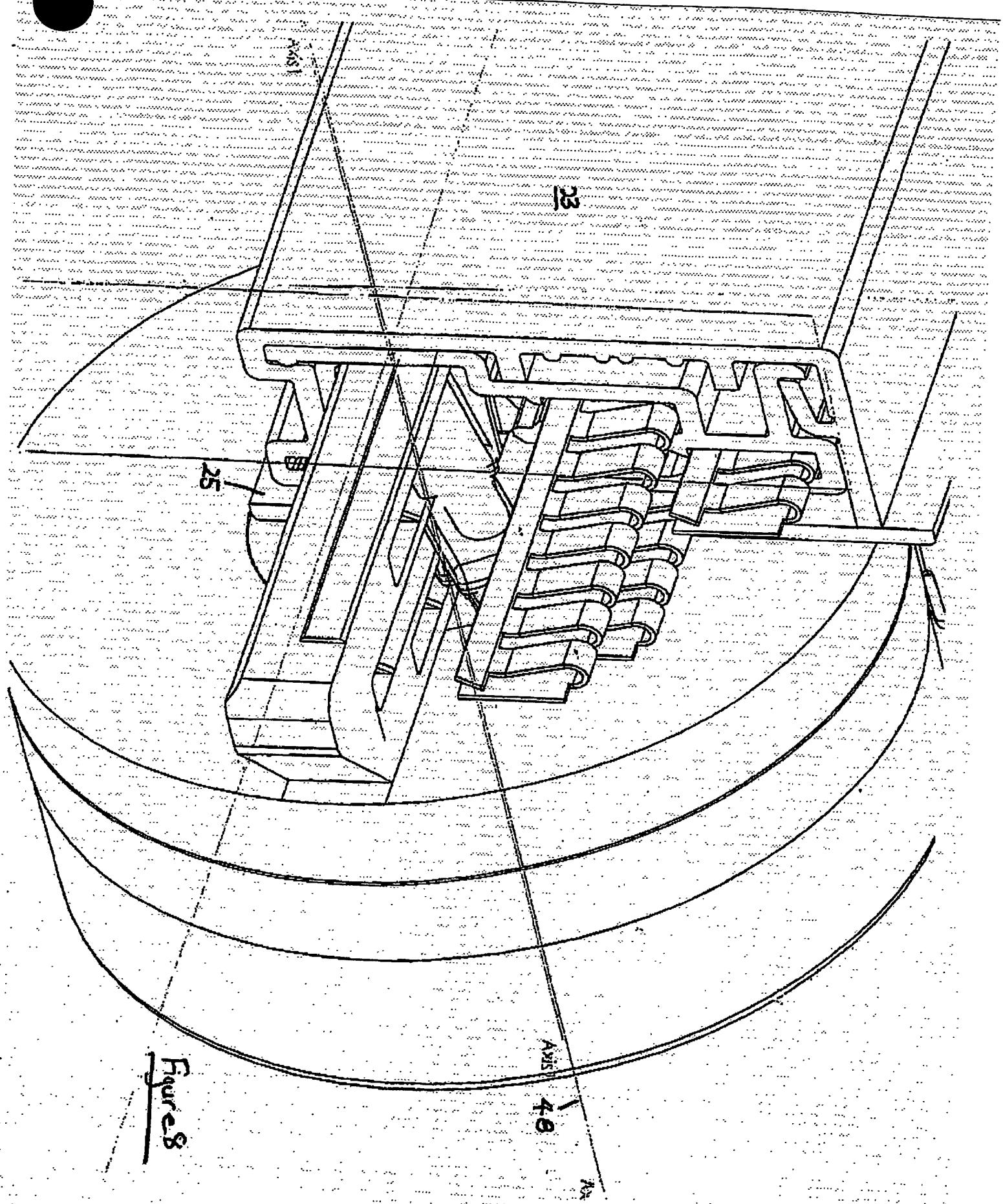
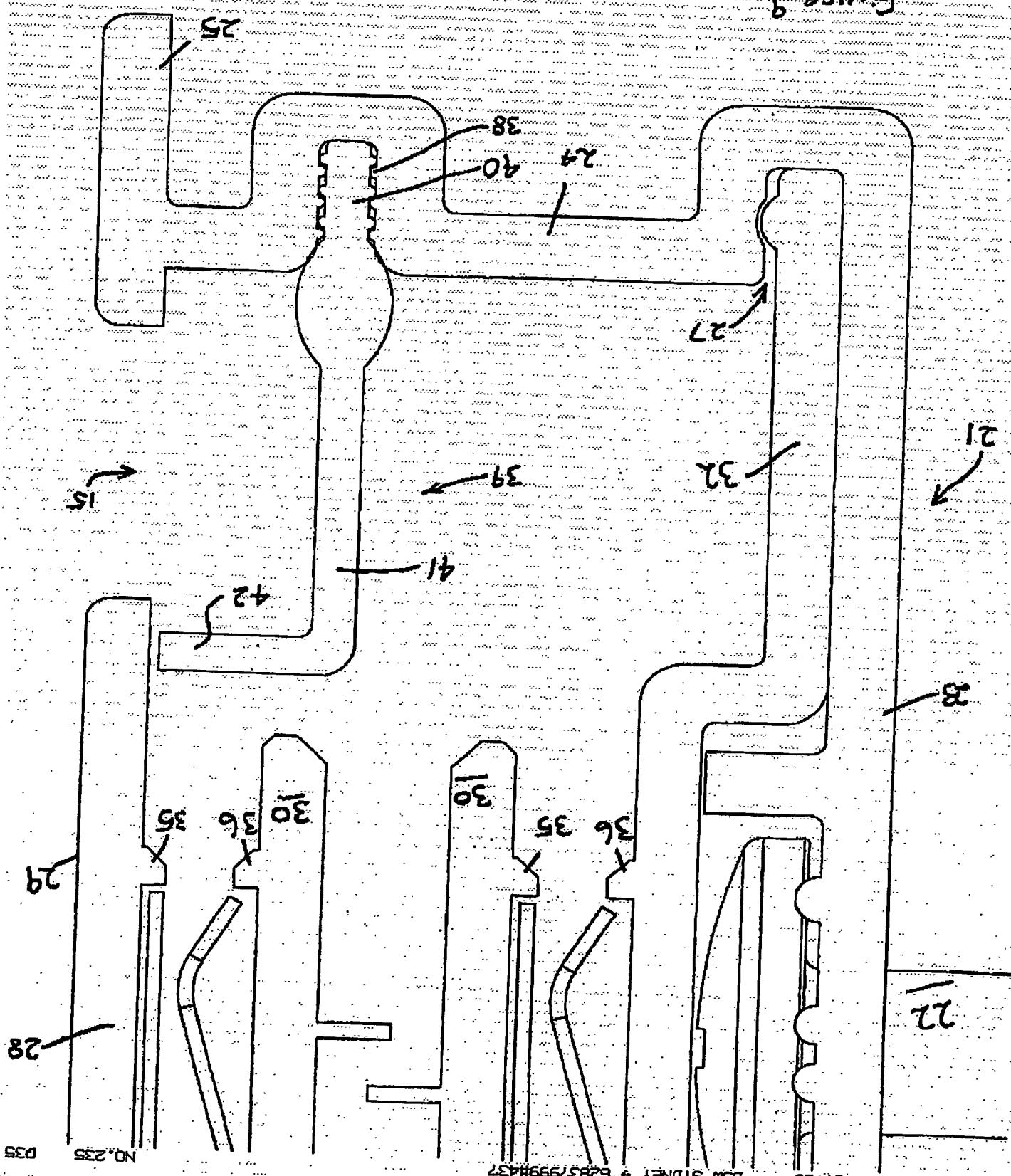


Figure 9

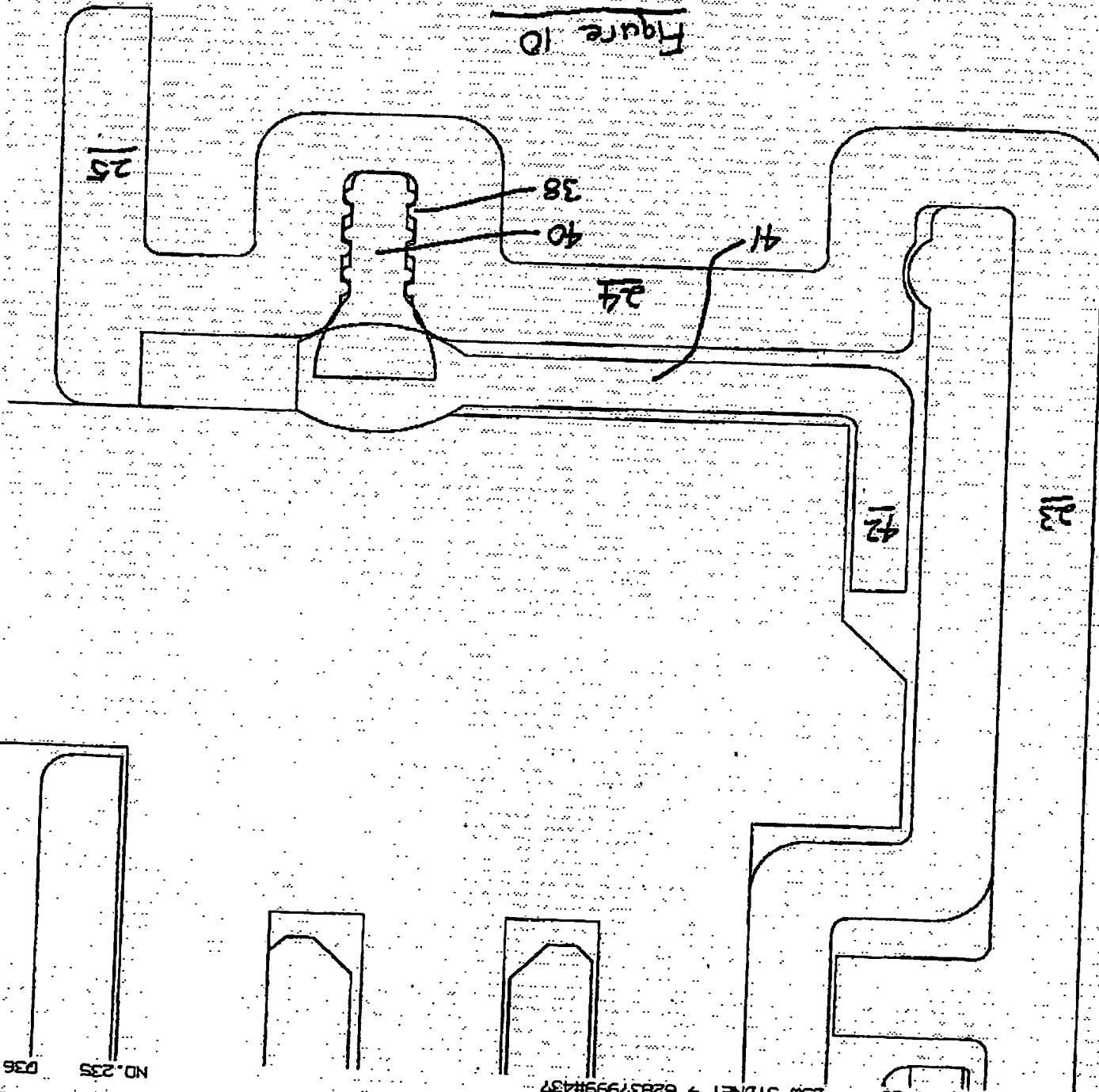


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Figure 10



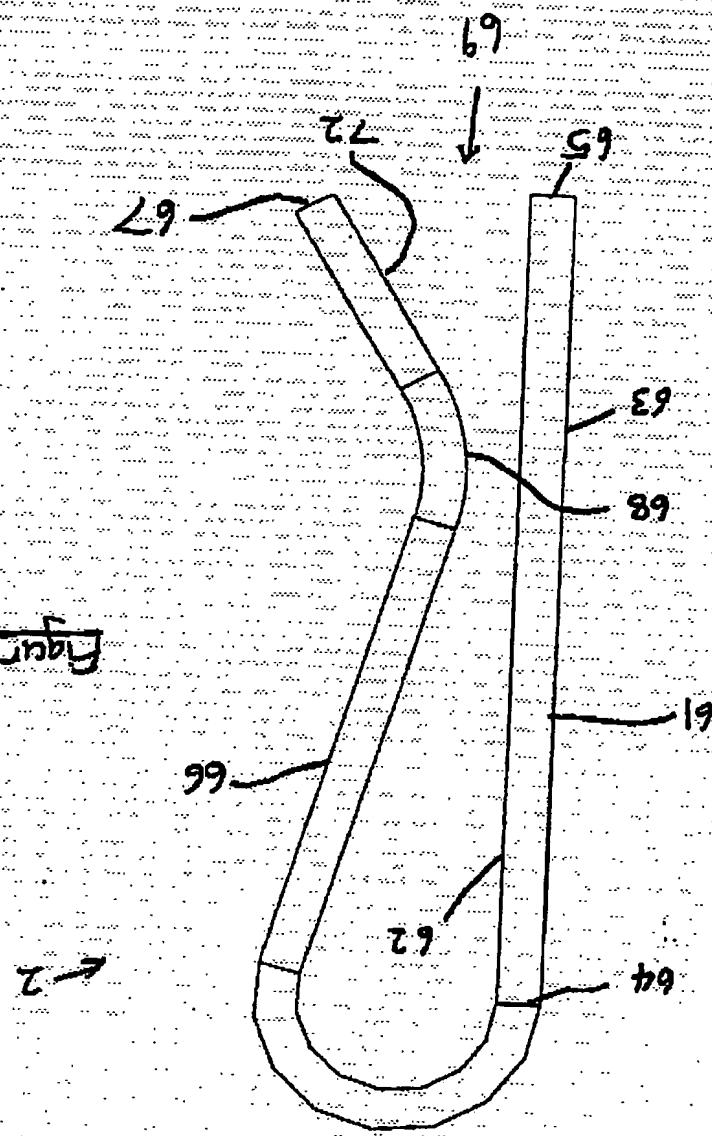
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Figure 12



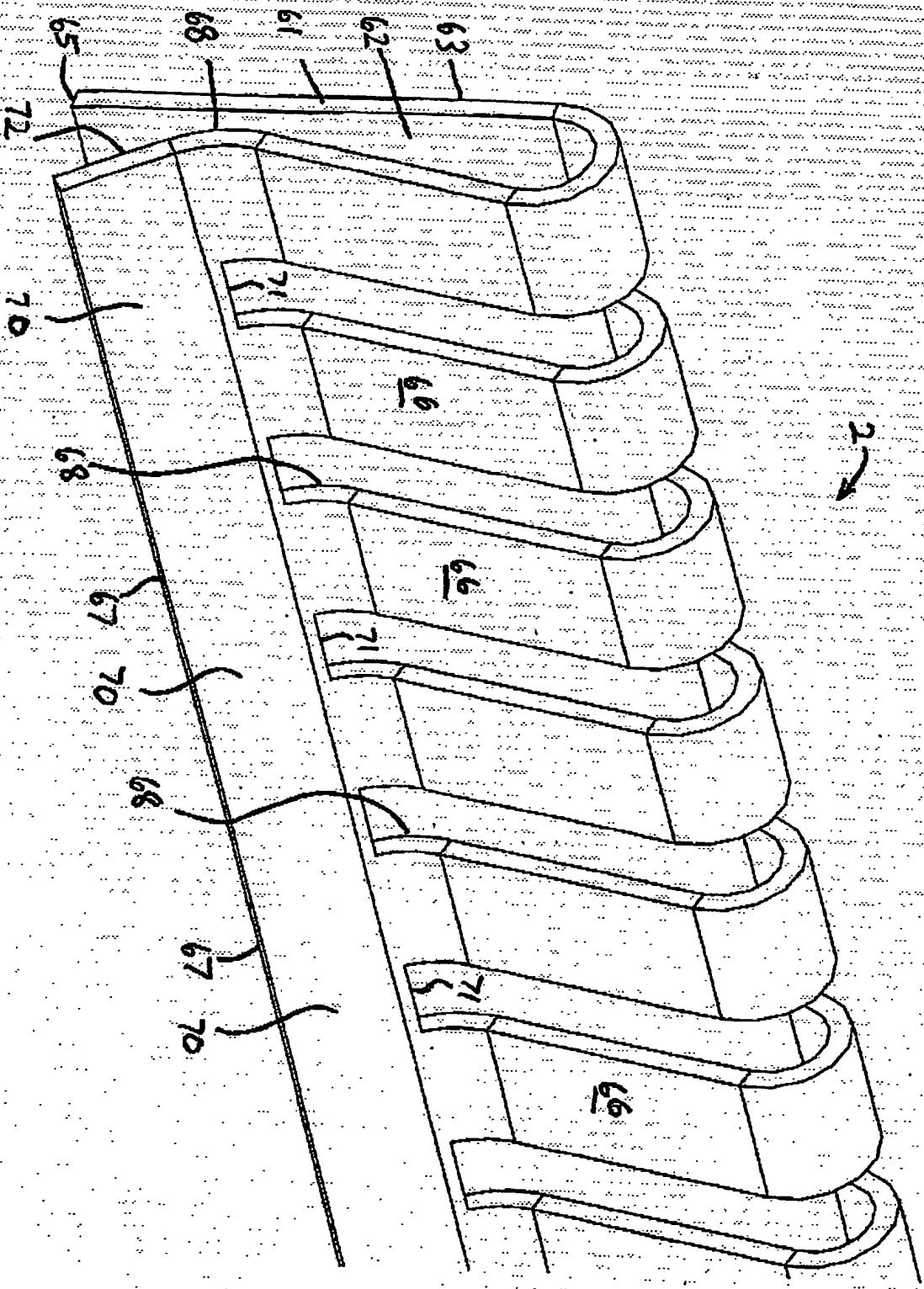


Figure 12

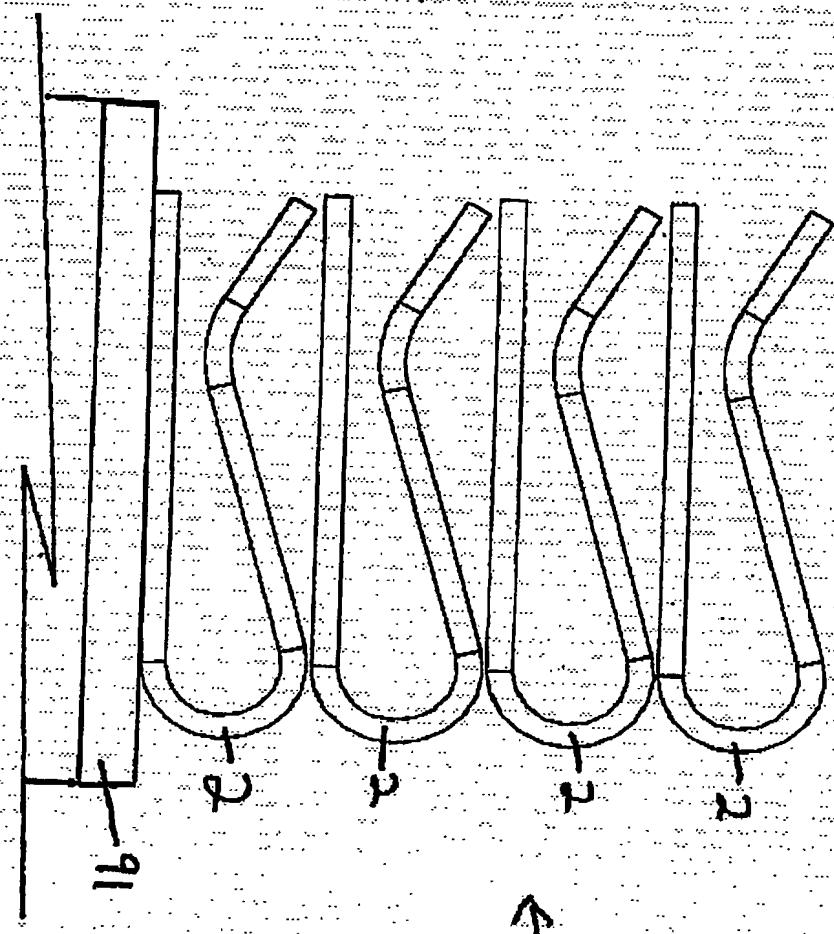


Figure B

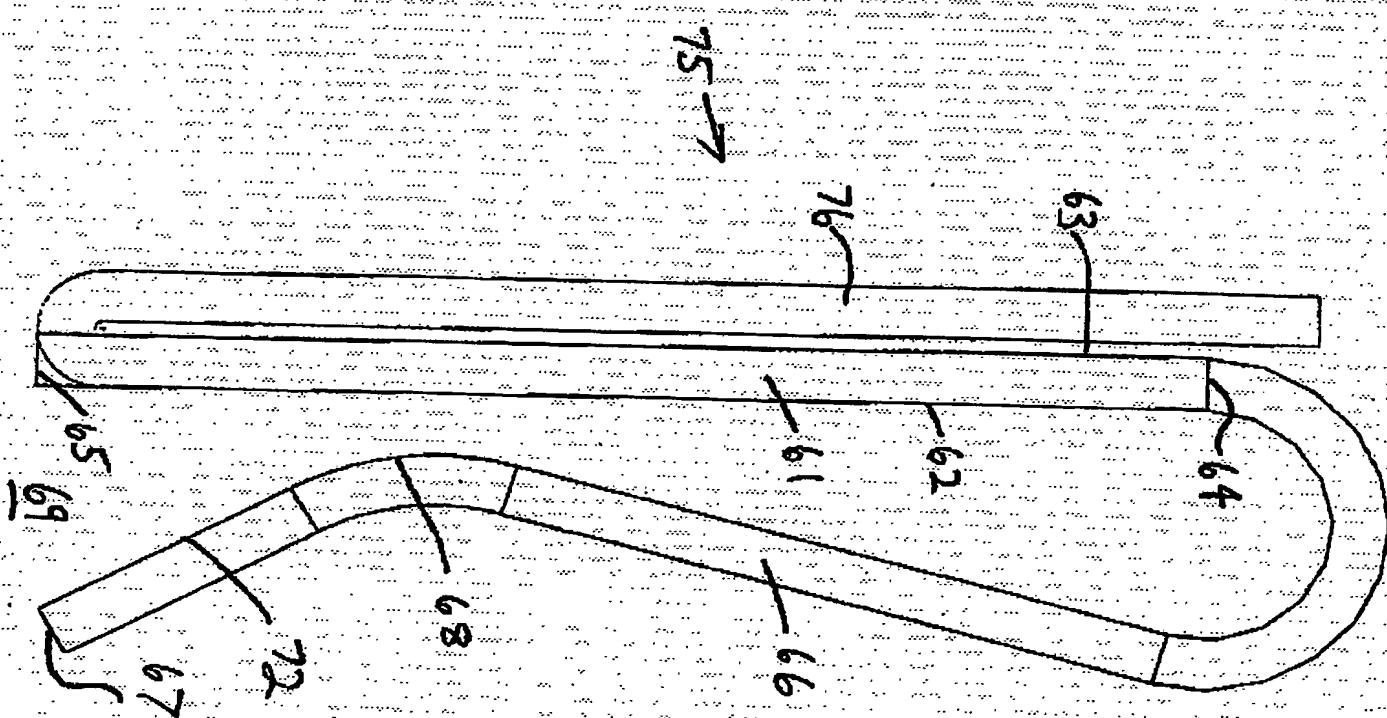
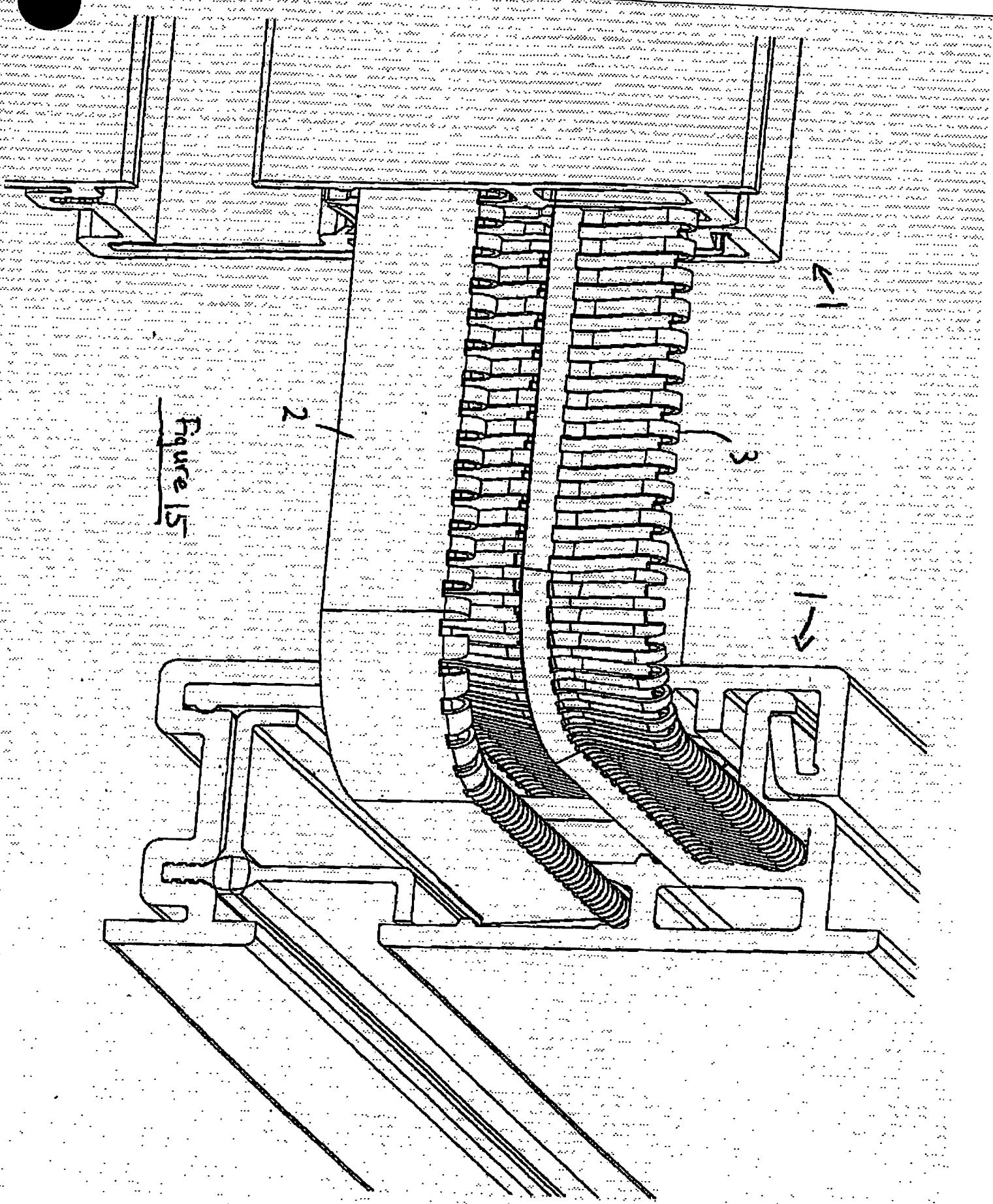
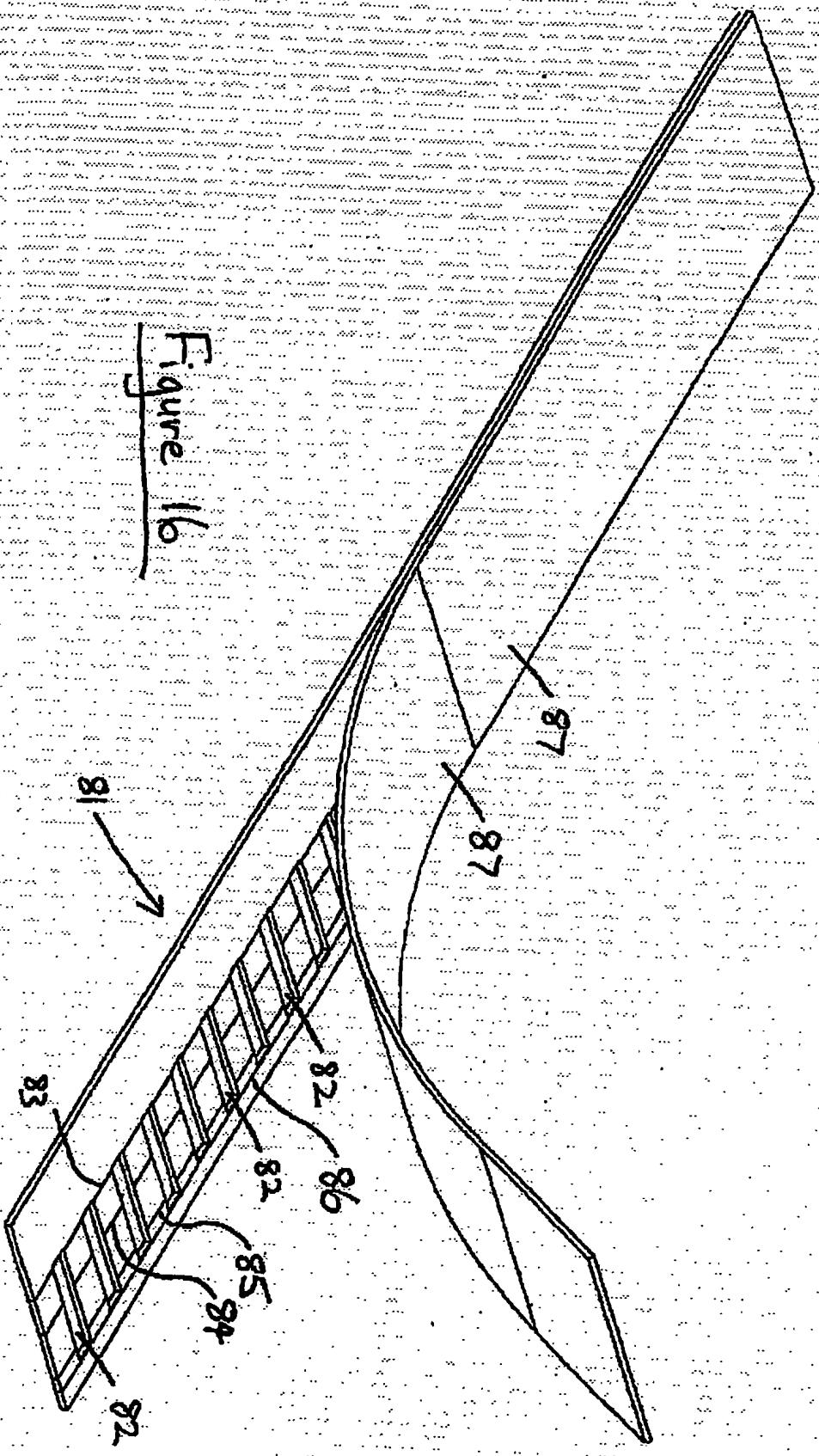
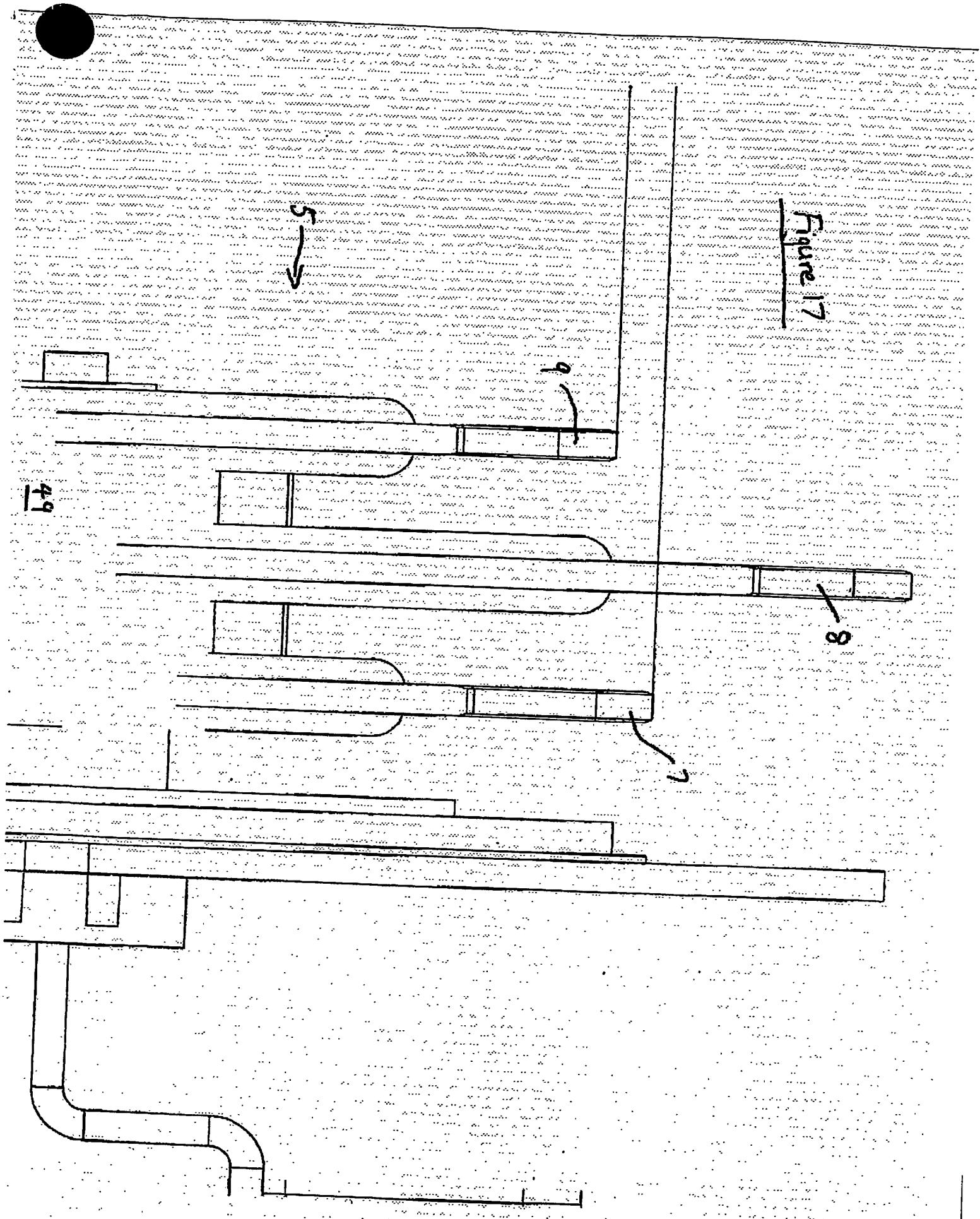


Figure 14





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